EXHIBIT C2

2.3. Measurement of Viscosity and other Rheological Properties

The measurement of the viscosity and other rheological properties, such as gel strength, can be performed using a variety of commercially available rheometers and viscometers. The methods for measuring these properties are well known (*see e.g.*, *Drilling Mud and Cement Slurry Rheology Manual*, Gulf Publishing: Houston, 1982). A common design for rheometers is that of the cup and bob. In this embodiment, a bob or spindle, which could be a circular cylinder, a disk or a thin cylinder, is placed in a cup containing the fluid to be characterized. In a typical rheometric measurement, the spindle turns at a prescribed number of rotations per minute (rpm) and the torque on the spindle is measured through a torsional spring. The greater the torque at a given rpm, the greater is the viscosity of the fluid. For a given spring, there is a range of torques that can be measured by the instrument. The percent torque is taken relative to the maximum of the measurable torque range. The percent torque can be converted to stress given the geometry of the spindle and cup and, if necessary, calibration with a fluid with known rheological properties. However, often the percent torque is sufficient to characterize a fluid for comparison to other fluids or to determine how the material responds in time, *i.e.*, whether it is thixotropic or rheopectic or the time for the gel to form.

Well-known examples of this design are the Fann Model 35 viscometer[3] and the Brookfield DV-II+ viscometer. For a non-Newtonian fluid, the

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[3] The Fann Model 75 uses this same method for measuring viscosity but is capable of testing under elevated pressures (up to 20,000 psig) and elevated temperatures (up to 500°F).

viscometer must be capable of testing at multiple rotational speeds. Both the Brookfield DV-II+ and Fann 35 are capable of operating at multiple speeds[4], so by testing at a variety of speed intervals, a technician can develop a profile of the viscosity of the subject fluid over a range of shear rates.

For fluids that exhibit thixotropic behavior and are gels, the following experimental protocol can be followed. First, the fluid is sheared at large rpm until the percent torque (say for a Brookfield rheometer) reaches a constant value. The spindle is then stopped for a period of time to allow the fluid to rest and form the gel. A smaller shear rate is then applied and the percent torque as a function of time is observed. The height of the peak indicates the strength of the gel and the time taken to reach the new steady state percent torque indicates the speed at which the gel breaks under shear.

2.4. Experiments Performed on Sample Drilling Fluids in Suit

Several rheological tests were conducted at Halliburton Laboratories in Houston, TX on March 2, 2006, to measure the gel set-up and relaxation for two different Accolade fluids. I performed the tests using fluids provided by Halliburton and using a Brookfield Rheometer also provided by Halliburton. The tests performed were those described in U.S. Patent Number 6,887,832 (hereafter referred to as the patent) to reproduce figures 3 and 4 in the patent. I was able to reproduce the results in those figures quickly, and the fluids I

[4] The Brookfield DV-II+ has a more versatile range of speeds—the DV-II+ can turn as slowly as 0.01 RPM while the lowest speed on a Fann 35 is 3 RPM. Depending on the fragility of the fluid being measured, 3 RPM may be too fast to accurately measure the yield point.

tested showed the same behavior as the fragile gels defined and described in the patent.

2.4.1. *Experimental Methods*

All the experiments were conducted on a Brookfield model LVDV-II+ viscometer. The accuracy of the instrument was verified by measurements of 20 centipoise (cP) and 200 cP viscosity standards provided to me by Halliburton. These viscosity measurements were made at room temperature (~20°C) using a cylindrical Brookfield spindle LV1 and a 600 ml glass beaker. The measured viscosities were within 5% of the viscosities of the standard. This verified the accuracy of the torque measurements by this viscometer.

The protocol for the experiments on the drilling fluids or muds was as follows. First, the drilling fluid was placed on a heated roller table to begin mixing and warming the fluid. The fluid was then poured into a mixing cup and blended using a milk-shake blender for 15-20 minutes to ensure that the fluid was well-mixed. This well-mixed mud was placed into a heated metal cup and maintained at a temperature of approximately 124°C throughout the experiments.

Two Accolade drilling fluids, Accolade #1 (having a density of 13.1 lb/gal) and Accolade #2 (having a density of 15.6 lb/gal), were tested according to the two protocols described below. Because the drilling fluid is a gel, a vane spindle was used to measure the resistance to flow. A standard Brookfield vane spindle 73 was used for these experiments. The spindle was lowered into

the cup to the appropriate mark on the spindle provided by Brookfield, and the measurements began.

Two types of measurements were conducted. For the so-called gel set-up experiment, the fluid was sheared at a high rate measured in rotations per minute for five minutes and stopped. The fluid was allowed to rest for another ten minutes and then a low shear rate was applied for another five to ten minutes. The percent torque on the vane spindle was measured throughout the experiment. For the gel set-up experiments on Accolade #1, the fluid was sheared at 100 rpm, the fluid was allowed to rest, and then sheared at 50 rpm. On Accolade #2, the fluid was sheared at 10 rpm, the fluid was allowed to rest, and then sheared at 5 rpm.

For so-called gel relaxation test, the drilling fluid was sheared at a low rate for five minutes, and then the motion of the vane was stopped. The percent torque on the vane spindle was measured for several minutes thereafter. For both Accolade #1 and Accolade #2, the spindle was rotated at 5 rpm for five minutes before stopping.

The general aspects of the two experimental protocols were determined by the description in columns 5 and 6 of the patent pertaining to figures 3 and 4 of the patent. The values for the shear rates (rpm), were set by trial and error with the aim to put the torque measurements generally in the center of the instrument's range.

The calibration test was conducted in about an hour on the morning of March 2. The remaining tests were completed in about three hours on the

afternoon of March 2. I conducted all the tests by myself. Staff at Halliburton only provided me equipment and materials for testing, namely the Brookfield viscometer and standard spindles and vanes, mixing equipment, a heating cup, thermometer, computer for data acquisition and the test fluids.

2.4.2. *Results*

The results for the gel set-up tests for the two Accolade fluids are summarized in figure 1. Note that the start-time for the test of the second fluid is shifted by 100 seconds so that the results do not overlap and are easier to read and compare. Both fluids show similar behavior. The percent torque rises rapidly (within seconds) when the first shear condition is applied, and the torque then falls off rapidly. This behavior is indicative of the thixotropic nature of these fluids. During the period of rest, the torque vanishes. When shear at a lower value is applied, the percent torque again rises rapidly, indicative of the formation of a gel. The torque again decreases with time and approaches the new steady-state value in about 30 seconds for Accolade #1 and in about 50 seconds for Accolade #2. Note that much of the reduction in the percent torque after the peak occurs in a few seconds, which is why the curves have a distinct "L" shape. The magnitude of the peak percent torque after the period of rest is indicative of the strength of gel. Because the peak percent torque of Accolade #2 is greater than that of Accolade #1, one can conclude that it has the higher gel strength. This figure is similar to that shown in figure 3 of the patent.

The results for the gel relaxation test for the two Accolade fluids are summarized in figures 2 and 3. Figure 2 shows the percent torque during the entire experiment. The signature thixotropic behavior is observed again. Note also that the steady-state percent torque for Accolade #2 is higher than that of Accolade #1 while both are sheared at 5 rpm. This indicates that Accolade #2 is more viscous than Accolade #1.

Figure 3 shows the percent torque from the moment after shearing stops, with the initial time set conveniently to zero. For both Accolade drilling muds, it is found that these fluids relax to their new state in about 5-15 seconds. This time is indicative of how long it takes for the gel to form. For Accolade #1, 95% of the stored stress relaxes to its final value within five (5) seconds. For Accolade #2, 95% of the stored stress relaxes to its final value in 15 seconds. This figure is similar to that shown in figure 4 of the patent, wherein the fluids of the invention reach their relaxed states faster than prior art fluids.

2.4.3. *Conclusions of Experiments on Drilling Fluids in Suit*

The gel set-up and relaxation of two Accolade fluids were tested on a standard Brookfield viscometer using a standard vane spindle. Based only on the information in the patent, the results of figure 3 and 4 were easily and quickly reproduced. The times for the gel to break and form for these fluids, as shown in figures 1-3 of this report, are on the order of tens of seconds. These values are consistent with those quoted in the patent and used to characterize the fluids as fragile gels.

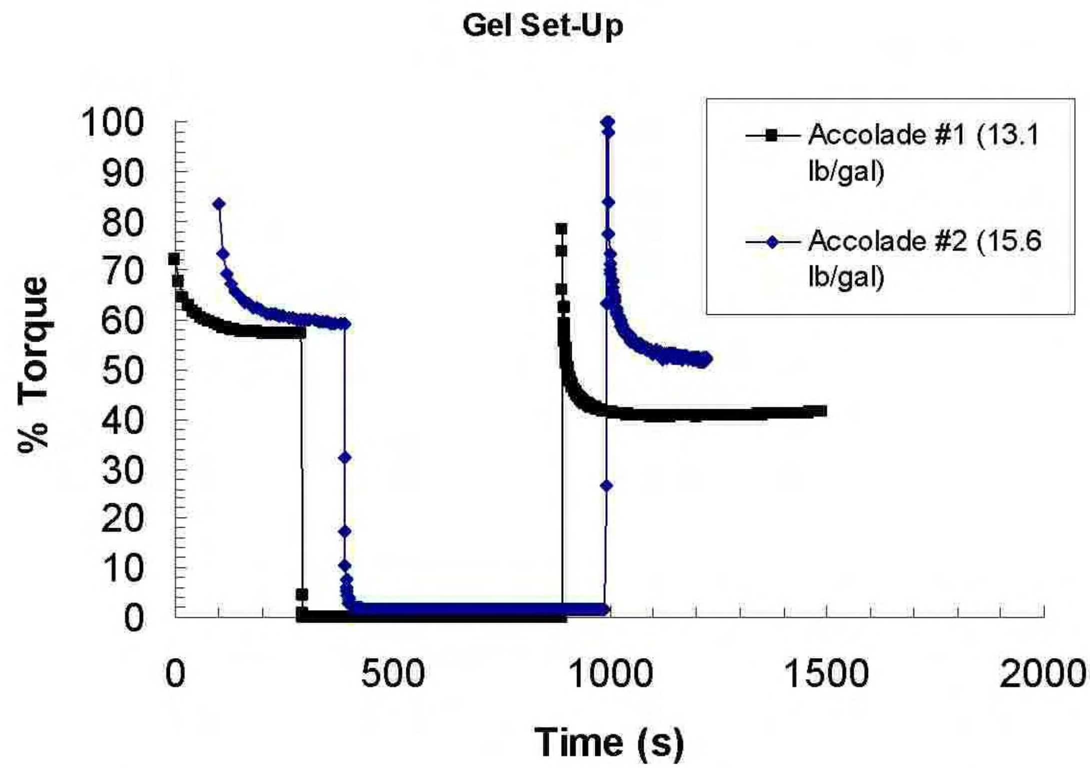

Figure 1. Percent torque versus time for two different Accolade fluids following the gel set-up test described in the experimental section.

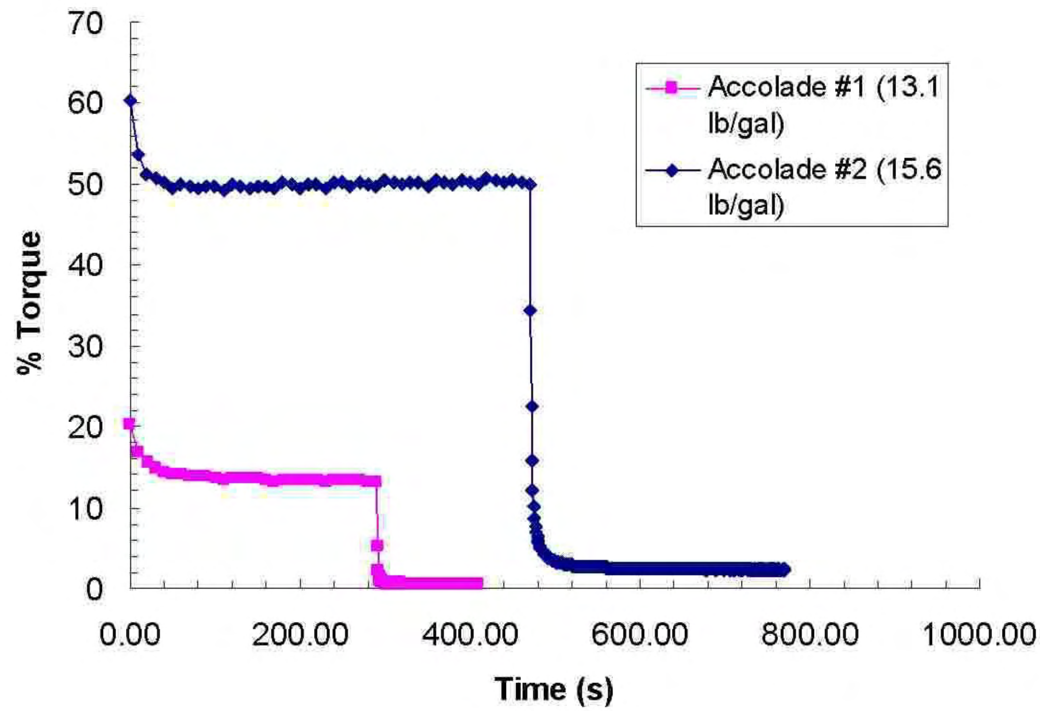

Figure 2. Relaxation test for two different Accolade fluids following the experimental protocol for the gel relaxation test described in the experimental section.

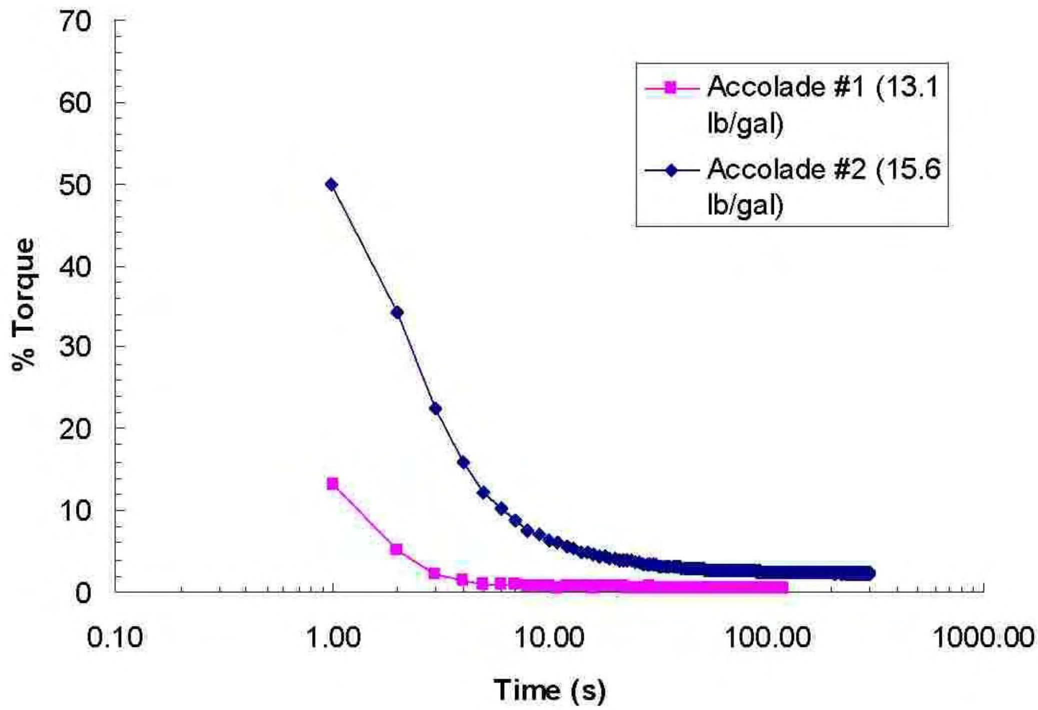

Figure 3. Relaxation test for two different Accolade fluids only for data after the shearing has stopped. The end of shear is now considered to begin arbitrarily at zero time.

3. Opinions Regarding Indefiniteness and Enablement

It is my opinion that one of ordinary skill in the art, given the claims and specification set forth in the '832 patent, would be able to make and use the claimed fragile gel drilling fluid, and would be able to determine whether or not a given experimental drilling fluid fell within the scope of the claimed fragile gel drilling fluid.

The patent teaches the formulation and use of an invert emulsion-based drilling fluid having very specific rheological characteristics. One of ordinary skill would recognize that the patent discloses:

- Multiple examples of formulations for the invert emulsion base, e.g., C11:L57-C13:L41.
- Multiple examples of formulations for thinners, e.g., C9:L22-C10:L57.
- Multiple examples of formulations for other additives typically used with drilling fluids, e.g, C10:L58-C11:L55; C13:L42-L65.
- That the drilling fluid would not need organophilic clay or lignite to provide viscosity, suspension, or filtration control (but that inclusion of some amount of organophilic clay or lignite was apparently permissible), e.g., C14:L1-L10, Claim 20.
- That the drilling fluid forms gels quickly when circulation stops but that the gels quickly break when circulation is resumed, e.g., C2:L27-L57; Figs. 3 and 4.

Regarding the formulations of the invert emulsions, thinners, and other additives used in creating the drilling fluid, one of ordinary skill in the art would have the competence to know what invert emulsions, thinners, and other additives he or she used in creating the experimental drilling fluid, and would be able to recognize whether or not they were within the range of formulations required by the claimed drilling fluid. Further, regarding the acceptable quantities of organophilic clay or organophilic lignite, one of ordinary skill would also understand, as described earlier in this report, how the materials in a heterogeneous fluid will interact to affect the rheological behavior of the fluid, and would understand that both organophilic clay and

organophilic lignite have a quaternary amine carbon chain. Thus, although they serve different purposes in the fluid, if the quaternary amine carbon chain of the organophilic clay had an attraction to another molecule in the fluid, one of ordinary skill in the art would expect that the quaternary amine carbon chain of the organophilic lignite would have a similar attraction. Further, one of ordinary skill in the art would understand that some amount of organophilic clay or lignite could be added before the attractive forces involving the quaternary amine carbon chain became so great as to interfere with the fragile gel characteristics of the drilling fluid (as determined by the experimentation described in the following paragraph).

Regarding the tests to determine fragile gel behavior, one of ordinary skill would understand how to test for fragile gel behavior as defined in the patent. Through a methodical set of measurements using standard tests and standard equipment (as taught by the patent, e.g., Figs. 3, 4, 9, and 10 (and accompanying text), C8:L30-L54, and C11:L17-L56), along with the instructions provide by the instrumentation manufacturer and in accordance with standard procedures such as those promulgated by the American Petroleum Institute, one could develop a rheological profile for the proposed drilling. The profile would include the data relevant to (a) the yield point, (b) the gel strength build-up as a function of time, and (c) the viscosity as a function of shear force. It would be a simple matter of repeating the measurements for a variety of formulations. The plots of torque values as a function of time would indicate the presence or absence of fragile gels. Further, by repeating the

measurements on a prior art fluid known not to exhibit fragile gel characteristics,[5] one could compare the rheological profiles for the different formulations of the experimental drilling fluid against the reference model, and readily determine which, if any, of the experimental drilling fluid formulations exhibited fragile gel characteristics.

Finally, it is my understanding the M-I asserts that, because the inventors did not disclose that the spindle used to run the Brookfield tests had been modified, that the results described, for example, in Fig. 3, are not reproducible. This assertion is wrong. First, as noted earlier in this report, a person of ordinary skill in the art would know that for non-Newtonian fluids that exhibit high gel strengths at rest but revert to a fluid with minimal pressure, a cylindrical viscometer spindle would be insufficient to measure the precise point at which the gels break. As such, a person of ordinary skill would know that to test such a vane spindle would be necessary to give the instrument sufficient precision. The '832 patent clearly shows differences between prior art drilling fluids and the drilling fluid of the invention, as exemplified by the plot of the data derived from the Brookfield instrument in Figure 3. A person of ordinary skill in the art would expect qualitatively similar results independent of the exact geometry of the vane spindle, and would know

[5] Petrofree SF is expressly named by the patent specification as a prior art invert emulsion drilling fluid. C5:L53-L58.

that the qualitative and relative data, rather than any specific numerical objective data, indicates the fragile gel behavior of a drilling fluid.[6]

4. Conclusions

Based on my years of experience, my understanding of the law regarding enablement, and my reading of the claims and specification of the '832 patent, and for the reasons set forth above, it is my expert opinion that the specification would enable one of ordinary skill in the art to make and use the claimed invention without undue experimentation.

Roger T. Bonnecaze 3/16/06
Roger T. Bonnecaze Date

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[6] I have reviewed the procedures and test results as described in the Declaration of Mr. Jeff Miller. It is my opinion that the tests were performed correctly and that the results corroborate my opinion regarding the use of modified spindles.